Emergency and Disaster Response to Chemical Releases

Technician Level Training

29 CFR 1910.120(q)

Module 8

Decontamination

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Table of Contents

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Acronyms Used in This Module

Decon	Decontamination
PPE	Personal Protective Equipment

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Overview

Module 8, addressing decontamination, will provide the participant with the knowledge and skills to decontaminate personnel properly after a chemical release response. This module examines levels and procedures for non-ambulatory victim decontamination, along with identifying decontaminants by type and applicability. It also provides the participant with the knowledge and skills needed to safely establish and operate a decontamination corridor.

Terminal Learning Objective

Upon completion of this module, participants will establish a decontamination procedure appropriate for the level of response to the incident.

Enabling Objectives

Based on the information presented in the classroom and in the participant guide, the participant will be able to:

- Select an appropriate decontamination procedure and determine the equipment required to implement the procedures for a selected chemical.
- Identify the purposes and effects of decontamination.
- Perform proper self-decontamination.
- Differentiate between emergency decontamination and technical decontamination.
- Identify steps taken to enhance safety of all personnel while conducting decontamination.

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Introduction

Decontamination ("decon"), which is critical to responder health and safety at spill and disaster sites, is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. Decontamination procedures protect workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used on site. These procedures:

- Protect all response personnel by reducing the transfer of harmful materials into clean areas;
- Help prevent mixing of incompatible chemicals;
- Protect the community by preventing uncontrolled transportation of contaminants from the site.

This module provides general guidelines for designing and selecting decontamination procedures at a scene and it presents a decision aid for evaluating the health and safety aspects of emergency decontamination methods.

All personnel, clothing, equipment, and samples leaving the cleanup area (generally referred to as the Exclusion Zone) must be decontaminated to remove any harmful chemicals. Decontamination methods may be either:

1. Physical removal.
2. Chemical removal (deactivation/neutralization).

Often, physical removal is used for gross decontamination, followed by chemical removal. Special kits for specific agents may be available for skin decontamination.

Physical Removal of Contaminates

The following methods are used to physically remove contaminants. In each case, the removed contaminant or wash water and the removed clothing must be collected for proper disposal. Materials for these methods are easily obtained.

- *Aeration*: For vapor contamination, place the victim outside in a breeze if possible, and remove outer clothing. (This may be sufficient decontamination for vapor-only exposure.)

- *Scraping, sweeping, brushing, or vacuuming*: Remove the bulk of the chemical agent by physical means (e.g., using a tongue depressor to scrape most of the agent off the skin).

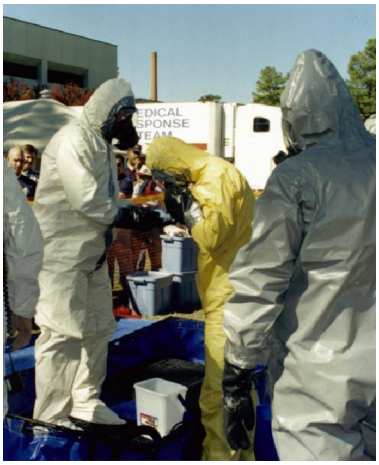
- *Hosing*: Flush the victim's body with large amounts of water (e.g., using a fire hose and spray nozzle). Water temperature is an issue because cold water can cause hypothermia in victims and personnel, even in warm weather.

- *Absorbent material*: Use absorbent material (e.g., flour, earth, dry soap powder, Fuller's Earth, Dutch Powder) to absorb the chemical; then wipe it off with wet tissue.

- *Soap and water*: Wash the victim with large amounts of soapy water (either fresh water or seawater).

Chemical Removal of Contaminants

In some cases, a particular chemical preparation can be applied to the contaminant that will react with it and convert it into something less toxic. Using the wrong chemicals, however, may cause dangerous interactions.



The most common chemical removal method used on people (as opposed to equipment and surfaces) is to wash the skin with a 0.5 percent hypochlorite solution (i.e., diluted bleach). Caution should be taken if decontamination occurs indoors because bleach solutions can cause off-gassing of chlorine vapor.

Types of Decontaminants

While there are numerous types of decontaminants available for use, they fall into three basic categories:

1. Commercial: Available stockpiles of these decontaminants may be quickly expended and not readily replaceable. Therefore, it is important that responders have an understanding of other decontaminants, their sources, and their uses.

2. Natural: It will reduce responder time and use of available decontaminants.

3. Standard military: If the military is called in to support the incident, military decontaminants may be available.

Decontaminants should be stocked and stored before any incident. They must be accessible and clearly marked for content. Test decontamination material routinely for viability (strength). Training must stress decontaminant use, application, and risk (e.g., agent use and contact time for personnel and equipment).

When capabilities and resources allow, decontaminants of choice are water only (good), soap and water (better), and household bleach (best). A five percent (5%) bleach solution applied to equipment (15-minute contact times) will decontaminate most chemical and biological agents. A 0.5 percent bleach solution followed by complete flushing is suggested when decontaminating people (though not matching exactly the recommended percentages, a standard rule of thumb is 10:1, or 10 parts water to 1 part bleach). Recent information published in the *Journal of the American Medical Association (JAMA)* has begun to question whether soap and water may be just as effective in decontaminating the skin.

Some people may have allergic reactions when decontaminating with bleach products. Do not apply the bleach solution to the victim's face.

Absorbents

Personnel may use commercially available materials for control of liquid contamination at an incident scene and removal of most gross chemical contamination from surfaces. Contamination will be transferred to the absorbent material that must be treated as contaminated waste and disposed of accordingly. Since there is no preparation time for absorbent material application, implement the material utilization as soon as it arrives at the incident scene.

Non-Aqueous Methods

Although non-aqueous (without water) methods provide a means for contaminant removal, they do have advantages as well as limitations. If their use is expedient, the use of dry, gelled, or powdered decontaminating materials for absorbing the chemical agent is appropriate.

Commonly available absorbents include the following:

- Dirt
- Flour
- Fuller's earth
- Baking powder
- Sawdust
- Charcoal
- Ashes

- Activated carbon
- Alumina
- Silica gels
- Clay materials

Although these absorbents may provide expedient means of decontamination, their effectiveness has not been determined.

The Department of Defense uses the M291 and M295 Skin Decontamination Kits, which employ a charcoal-based resin absorbent and are available for commercial purchase. However, while these kits are effective in removing spots of liquid chemical agent contamination, they may not be suitable for treating mass casualties. This is due to their potentially limited availability and the relatively high labor requirements because of the size of the decontamination pad and the time it takes to clean large amounts of contamination from the victim.

Reactive foams are polymeric materials containing reactive agents that can readily decontaminate chemical warfare agents. Personnel can mix the foam with water and various co-solvents to aid in their use. Developers engineer the foams in a way to ensure limited use of solvent. Not only does this reduce their dependency upon solvent volume, but it also aids in the cleanup after use.

After the solvent evaporates, the foam collapses and turns into a powder. This allows for a simplified final clean-up operation. However, since researchers have not identified a single enzyme that is effective on all classes of chemical agents, one would have to use several enzymes simultaneously.

DECONTAMINATION SOLUTIONS

1. For solvents, acid wastes, and organic compounds use a 5% sodium carbonate and 5% trisodium phosphate solution.

   4 lbs sodium carbonate

   4 lbs trisodium phosphate

   10 gallons water

2. For heavy metals, cyanides, ammonia, PCBs, and pesticides use a solution of 10% calcium hypochlorite

   8 lbs calcium hypochlorite

   10 gallons of water

3. For a general duty rinse, use a solution of 5% trisodium phosphate.

   4 lbs trisodium phosphate 10 gallons of water

4. For caustic wastes, a dilute acid may be used such as 1 pint of

concentrated hydrochloric or muriatic acid in 10 gallons of water.

Isolation of Contaminants

Commonly called "dry decon," this process removes contaminated equipment and protective clothing from the worker and leaves it at the decontamination area. The material may be bagged, drummed, or both depending on the level of contamination.

The "dry decon" process is the simplest decontamination procedure to set up and requires a minimum number of personnel to operate. This process is most commonly used in small spills, spills of very toxic material, spills in isolated areas, and when using limited-use or disposable personal protective equipment.

Disposal Methods

All equipment used for decontamination must be decontaminated or disposed of properly. All decontamination waste must be handled as hazardous waste unless it can be confirmed as non-hazardous. Buckets, brushes, clothing, tools, and other contaminated equipment should be collected, placed in containers, and labeled. Also, all spent solutions and wash water should be collected and disposed of properly. If heavily contaminated, the liquids should be drummed for disposal as hazardous waste. Clothing that is not completely decontaminated should be placed in plastic bags, pending further decontamination or disposal.

Pollution Prevention

An effective decontamination procedure will prevent pollution of the environment beyond the Contamination Reduction Zone. Proper cleaning and/or disposal of PPE and contaminated equipment along with containment of wash water helps to ensure that no additional damage is inflicted on the environment.

Personal Protection

Decontamination

Decontamination workers who initially come in contact with personnel and equipment leaving the Exclusion Zone will require more protection from contaminants than decontamination workers who are assigned to the last station in the decontamination line.

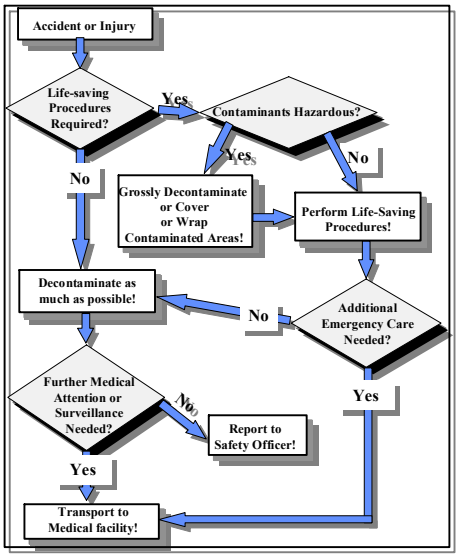
In some cases, gross decontamination personnel should wear the same levels of PPE as entrants in the Exclusion Zone. In other cases, decontamination personnel may be sufficiently protected by wearing one or two levels below that worn by the entrants. The safety officer or incident commander should approve protection levels based on knowledge of hazards and the number of response personnel available.

Decontamination Facility Design

Decontamination procedures must provide an organized process by which levels of contamination are reduced. The decontamination process should consist of a series of procedures performed in a specific sequence. Outer, more heavily contaminated items should be decontaminated and removed first, followed by decontamination and removal of inner, less contaminated items (e.g., jackets and pants). Each procedure should be performed at a separate station in order to prevent cross contamination. The sequence of stations is called the decontamination line. Stations should be separated physically to prevent cross contamination, preferably in a straight line.

Emergency Decontamination

In addition to routine decontamination procedures, emergency decontamination procedures must be established. In an emergency, the primary concern is to prevent the loss of life or severe injury to site personnel. If immediate medical treatment is required to save a life, decontamination should be delayed until the victim is stabilized.



If decontamination can be performed without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life, decontamination must be performed immediately. If an emergency due to a heat-related illness develops, protective clothing should be removed from the victim as soon as possible to reduce the heat stresses. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing

and equipment.

Emergency Decontamination Flow Chart

Personnel must be prepared to conduct emergency decontamination and to set up a decontamination corridor. To do this, select and secure a large area upwind and uphill of the Hot Zone. Provide protection for and be able to accommodate the decontamination of large numbers of victims. Base an emergency decontamination operation on speed rather than on neatness.

The sooner one begins and completes decontamination the better, as time will be a critical element. The decontamination process also has the potential of creating a hazard. Notify the proper authorities downstream if personnel cannot confine runoff to the incident scene. To reduce this hazard, personnel must:

- Control decontamination runoff as best as possible. Know where it is going and ensure that it will not flow into clean areas.

- Coordinate with local environmental management officials if possible. Confinement may be critical if radiological materials are involved.

- Establish measures for decontamination of fatalities. One method is the establishment of an additional lane within the decontamination corridor. Consider the psychological implications of co-location with living victims and the potential need for autopsy for evidence as factors in determining where to establish decontamination facilities for fatalities.

Decontaminate Victims

After establishing the decontamination corridor, personnel must effectively communicate to victims what action can be expected as they pass through the corridor during the decontamination process (i.e., spread arms/legs out and wash from top down). During decontamination, have victims remove outer clothing down to their undergarments to increase the thoroughness of the decontamination process. Removal of clothing removes approximately 80 percent of the contamination.

Additionally, consider implementing the following techniques:

- Remove panty hose, which can hold contaminated liquid and vapor close to the body.

- Use bags such as trash bags, biohazard bags, or other suitable bags of size and strength to collect and identify individual clothing removed from victims.

- Place bagged clothing into sealed containers (tagged for identification) for a more thorough inspection later.

- If the hazard is biological or radiological, wet the victims down before removing individual clothing. This will embed the agent on the clothing of the victims and reduce the potential for the biological or radiological agent adhering to the bodies of the victims or becoming re-aerosolized.

Liquid or aerosolized chemicals can pose an ongoing threat to the victim because of the risk of continued absorption. For many chemical agents, rapid decontamination is critical because the agents (especially nerve agents) can cause injury in a matter of minutes. Vapor exposures do not require decontamination.

Non-Ambulatory Emergency Decontamination of Patients

Emergency decontamination for non-ambulatory victims at a spill and disaster events presents many challenges to response personnel. Responders must be able to perform cutout procedures efficiently in order to accommodate for the numerous victims needing immediate medical attention. Additionally, take precautions to prevent the spread of contamination to self or team, victims, and uncontaminated ground.

To minimize personnel and victim exposure during the decontamination process:

- Select personal protective equipment at a level that protects the worker against the threat (nerve agent, bio agent). When the agent is unknown, OSHA requires PPE Level B at a minimum. However, Level A protection is recommended for additional safety until the agent has be identified.

- Wear positive pressure self-contained breathing apparatus (SCBA).

- Limit the number of workers that come into physical contact with victims.

- When handling victims, consider these techniques to provide protection for them:

    - Use supports to hold stretchers and backboards off the ground (e.g., milk crates or saw horses).

    - Keep clothing away from the victim's face during removal (limits victim breathing in the agent).

    - Remove/cut clothing from head to toe, front to back.

- When removing clothing from victims, do not cut through holes or tears. These are clues to the event and may prove to be useful evidence.

- Control and monitor all workers' activities throughout the incident for accountability and treatment in the event they become contaminated. If workers become contaminated, they may be required, on occasion, to conduct self-decontamination procedures to ensure their own safety.

Technical Decontamination

When setting up the technical decontamination corridor, establish it away from the emergency decontamination corridor. In the emergency decontamination process, the emphasis is on speed and CBRNE agent removal since victims have no protection against the agent. Technical decontamination concentrates more on completeness and deactivation/neutralization since the responders are in protective clothing.

The distance between the stations of the corridor is critical in minimizing the vapor hazard and cross contamination. The distance is most critical at the last station where personnel remove their respiratory protection and move to the Cold Zone. The Incident Commander will establish the distances required between stations based on:

- Weather conditions.
- Type of agent used.
- Number of victims.
- Time restraints.
- Space available.

BASIC SIX-STEP DECONTAMINATION LINE

STATION 1 EQUIPMENT DROP

Deposit equipment used on-site (tools, sampling equipment, monitoring instruments, radios, etc.) on a drop cloth. Segregation at this point reduces cross contamination.

STATION 2 GROSS DECONTAMINATION

Wash and rinse gross contamination from workers' boots and gloves if contaminated.

STATION 3 AIR TANK CHANGE

If worker needs a new air bottle only, the bottle is exchanged and worker returned to task. If worker is leaving the work area, SCBA backpack is removed and SCBA is deposited on plastic sheet to be decontaminated. Facepiece is left on. At this station, empty air bottles are decontaminated before refilling and SCBAs are decontaminated if possible. SCBAs needing additional decontamination are bagged and labeled.

STATION 4 BOOTS, GLOVES, AND OUTER GARMENT REMOVAL

If there is evidence of contamination, the boots and gloves are left taped to the outer garments For removal, worker steps into an open plastic bag and the garments and gloves are pealed off and down into the bag. The last step has the worker step out of the boots, leaving contaminated material in the bag.

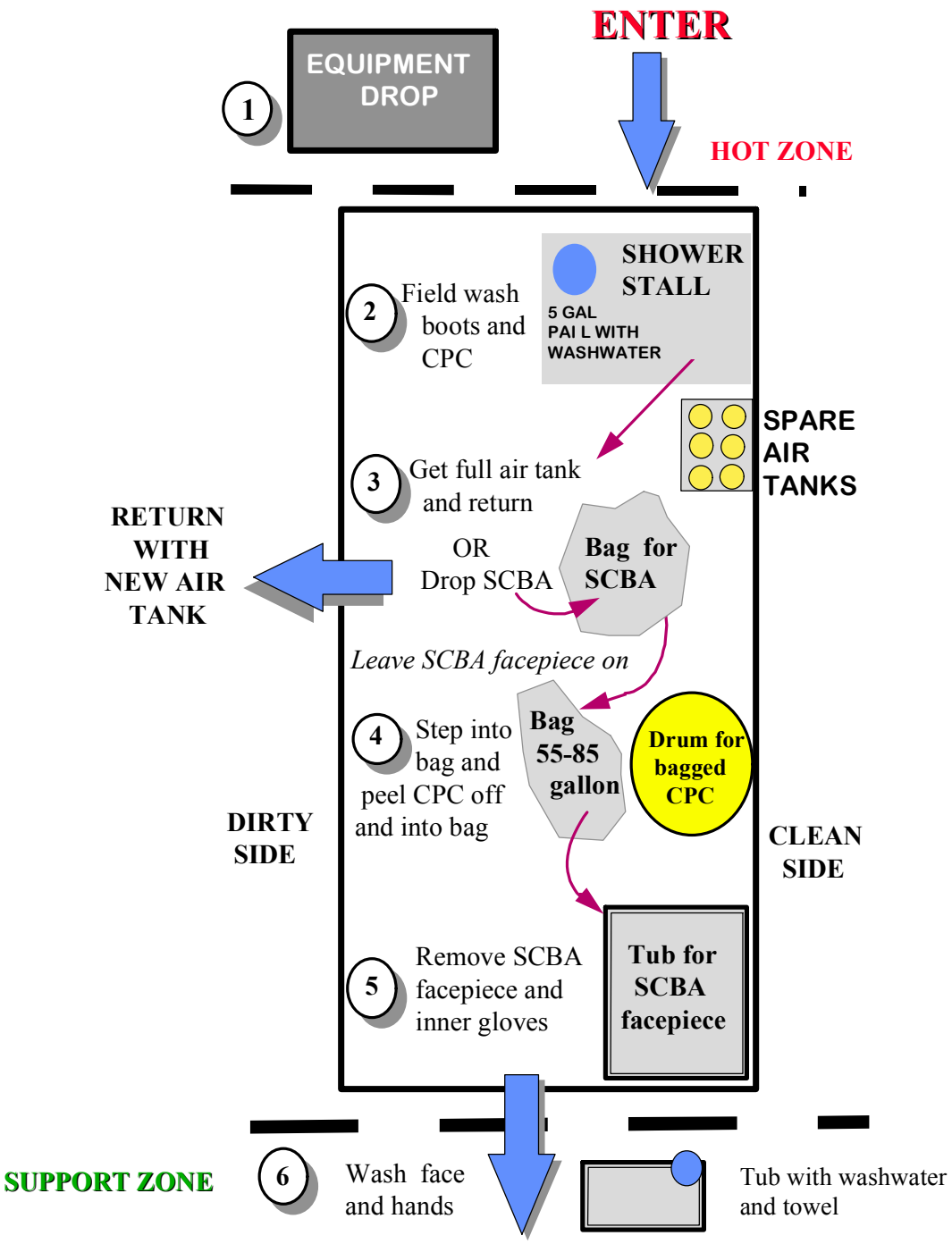
STATION 5 SCBA FACEPIECE REMOVAL

Worker removes SCBA facepiece for decontamination and then inner vinyl gloves are removed and deposited in a plastic-lined container.

STATION 6 FIELD WASH

Hands and face are thoroughly washed.

Six-Step Decontamination Line



Summary

Following are key points for personnel to remember when conducting decontamination:

- Safety of all workers is of paramount importance.
- Emergency decontamination of victims must be accomplished quickly.
- As decontaminants:
    - Water is good.
    - Soap and water is better (best in mass decontamination).

Review Questions

1. What procedures should be established in order to minimize the potential for contamination?

2. In general, what three categories do decontamination methods fall into?

3. Describe a basic decontamination line.

4. What could be considered the best form of decontamination?

   Why?

5. Why might the isolation of contaminants or "dry decon" be the method of choice for decontamination?

6. What are the primary considerations for emergency decon?

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